Increasing Student Engagement and Attention through Pre-Reading

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Abstract: *- This paper presents the experience of introducing the requirement of pre-reading into the Photonics course in the Electrical and Electronic Engineering program at Victoria University. The teaching of this course was changed to problem-based learning (PBL) mode in 2009. In order to accommodate for the extra hours working on projects, but still ensure that the course content was not reduced, the lectures were undertaken using Just-in-Time-Teaching mode and students were required to pre-read course materials before attending each lecture. Students were tested using online assessments prior to each class. These on-line tests contributed to their overall assessment. These tests provided immediate feedback on what the students did or not understand. This information became the basis for discussions in the class thereby focusing class time on areas in the course content that required most attention. Thus the lectures and class discussions are driven directly by the students. Students who understood the teaching material and received satisfactory marks in on-line assessment were not required to attend lectures, affording them more time to spend on their projects. However, attendance rates continue to be high though-out the semester as students responded well to this mode of teaching.*

Index Terms – *Just-in-Time Teaching, Online Assessment, Pre-reading, Student Engagement.*

Introduction

In the Bachelor of Engineering in Electronic and Electrical Engineering program at Victoria University, students undertake a course in photonics. This course introduces the students to the world of optoelectronics as another application to electronics. The course covers such topics as light emitting diodes, lasers, solar cells and fibre optics. The course is offered in the 3rd year of the program for one semester and has a work load of six credit points, equivalent to one eighth of the semester load. This translates to two and a half hours of contact time. In the past, these contact hours were divided into one hours of lectures, one hour of tutorials and an average of half an hour per week of laboratory work over twelve weeks of the semester. The mode of delivery was traditional instruction-based teaching in both the lectures and the laboratories. In 2009, the course was changed to problem-based learning (PBL) mode in order to make the course more interesting and relevant to the electrical engineering discipline. Students now spent, on average, one hour per week on projects and one and a half hours per week on theory. Often, a change in course structure to PBL results in a reduction of teaching time and the teaching content to make for the increased time spent on problems [1]. In order to ensure that the course content was not reduced, the theory was delivered in Just-in-Time Teaching (JiTT) mode [2]. Under JiTT, the learning materials are provided to the students prior to class and pre-reading is required before the student comes to each class. Pre-reading the teaching material just before class allows the students to familiarise and absorb the teaching content in their own time and at their own pace. Students were assessed on the material using online assessment. If students understood the material and received satisfactory scores in their online assessment, they did not need to come to the class, but instead, can spend more time on their PBL projects or other subjects. This afforded students greater flexibility in their study time.

Course Structure

The course content was divided into 11 core topics. Each topic was covered in the one and half hour lecture period per week. Each topic consisted of a set of lecture notes that are ten to twelve pages long and written in a book chapter-style format. It was important to ensure that the teaching material was of high quality and that all of the information needed by the students to undertake tutorial exercises was included. In addition, the topics need to be contextualised so that students understood the relevance of the topic and why they were studying it. The first page of each topic chapter always provides a brief background and context to the topic. All of the lecture notes were delivered to students at the beginning of the semester via the Blackboard/WebCT online course management system. In addition, links to other online resources such as animations and applets that illustrate the key physics principles covered in the topics were also listed on WebCT.

Just-in-Time Online Assessment

In order to ensure that students did indeed read the material and are prepared for class, they were assessed on the material before each class using online assessments. Students are given up to one day before the next class to complete the assessment. Each assessment consisted of typically two to three concept questions designed to test the student's understand of the key concepts explored in the topic. These questions were not calculation questions, but rather short answer questions. In addition to the conceptual questions, two additional questions were asked that gauged the student's performance for the week and how hard they found the topic to be. The first of these questions is an understanding question that asks which sections in the weekly topic they found most difficult to understand. If nothing was difficult, then the students were asked what section of the topic they found most interesting. The final question in the each assessment asks the students how much time they spent studying for this unit in that week. An example of the online assessment is shown in figure 1.

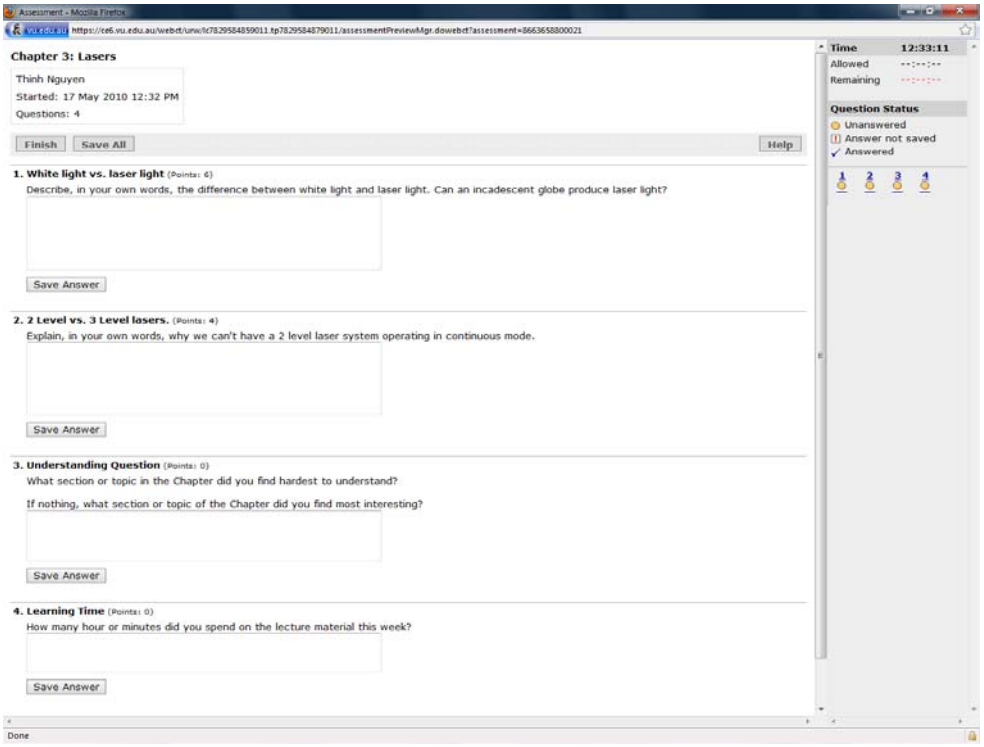

FIGURE 1
Example of the weekly online assessment.

Using Assessment Results To Instruct Teaching

The feedback from the "conceptual" and "understanding" questions was useful in deciding on what section of the topic to focus class discussions on. Lecture times were not spent on teaching the material in the traditional instruction-based lecture mode. Rather they were used as discussion time to explain sections of the topics that students found hardest to understand, or found most interesting as identified by the "understanding question" [3]. If there was one particular area which students found the most difficult to understand, then most of class time was spent on this topic area. This is a more efficient use of the teaching time than a traditional lecture and leads to a more relevant experience for the students as the topics of discussion centred on their learning requirements. Thus class discussions are driven by the student and not the teacher. Feedback from student evaluations showed that students appreciated having to read the learning materials beforehand as it made them more prepared for class. Students understood the topics been covered and the discussions much better as a consequence of the pre-reading. Students were more engaged and became more active in discussions and in asking questions.

Students who understood the learning material were not required to come to lectures. Instead, they would use this spare time working on their laboratory projects in addition to the allocated project time. Despite this flexibility in learning time, class attendance remained consistently high throughout the semester. The weekly

attendance rates for 2009 and 2010 are shown in figure 2. The average attendance throughout the course was 72% and 84% for 2009 and 2010 respectively. The high attendance rate is an endorsement of students engaging in the learning.

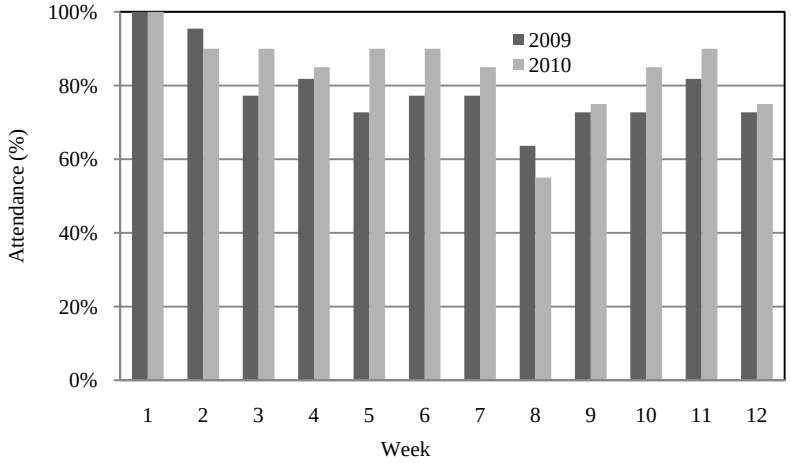

FIGURE 2
Attendance rates of lectures in 2009 and 2010. Average attendance rate was 72% and 84% for 2009 and 2010 respectively.

The final question in the each assessment asked the students how much time they spent studying for this unit throughout the week. The weekly average time spend on studying per contact hour is shown in figure 3. This question helps the teacher to determine which topics in the syllabus were the most difficult or easy, thereby allowing for the content to be appropriately revised and adjusted. For example, Figure 3 shows that students found week 6 to be the hardest. This corresponded to the introduction to optical fibres and waveguides and involved the study of optical modes. Students have not been exposed to this type of theoretical analysis thus they required more time to study the topic. The data showed that students spent an average of 2.4 and 2.5 hours for every hour of lecture studying the learning material before attending class in 2009 and 2010 respectively. This is also evidence that students are further engaging in the course.

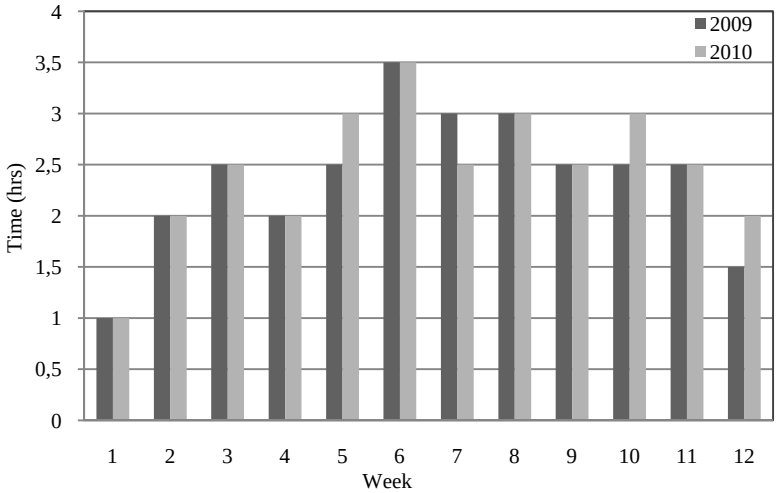

FIGURE 3
Average hours spent on learning per contact hour.

Another benefit of the online assessment is that feedback to the students can be provided almost immediately to specific questions. This form of feedback and formative assessment is an important part of the student's learning process and research has been shown to be effective in aiding student learning [4]. It also allows for the identification of students who are at risk.

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Improved Outcomes

The requirement for pre-reading was part of a wider strategy to engage students in the topic which also included using problem-based learning for their practicals. The overall aim was to promote deeper learning and improve overall student pass rates. At the time of writing, the final assessments for 2010 have not been completed and only 2009 results are presented here. The 2009 results are compared with 2008 in figure 4 which shows the percentage of students in each grading category for the two years. It should be noted that 2008 classes were run in the traditional lecture mode. The data shows an improvement in the grades with a smaller number of students failing compared to 2008. In addition, more students achieved higher grades in the 'credit' and 'distinction' category.

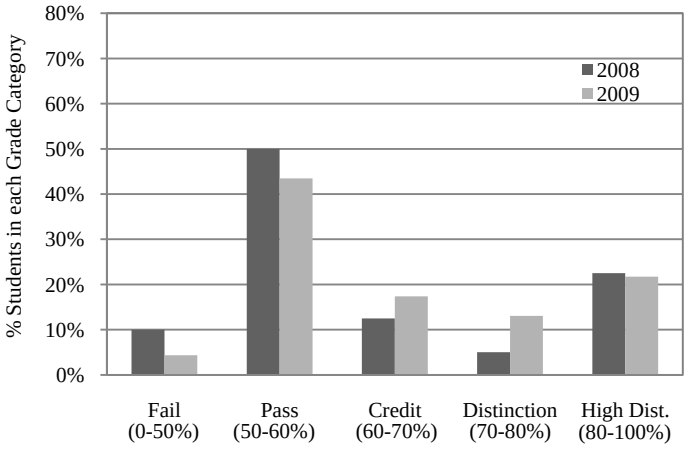

FIGURE 4
Pass rates in Photonics for 2008 and 2009.

While these improvements in the overall results may seem small, it is worth comparing the performance of the same students in other courses also. Figure 5 shows the percentage of students in each grading category for two other courses that were ran during the same time as the photonics course. It should be noted that other courses that made up the 48 credit points required for a semester's load were new to 2009 and the performance of the students in these courses could not be compared.

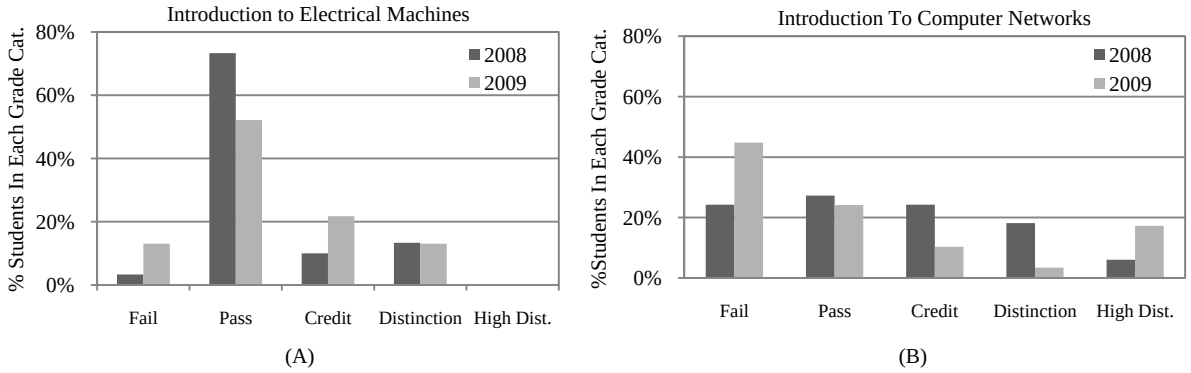

FIGURE 5
Percentage of students in each grading category for (A): Introduction to Electrical Machines and (B): Introduction to Computer Networks for 2008 and 2009.

Figure 5 shows that the same students faired much worse in the other courses compared to 2008. There were higher failure rates in both courses. In contrast, a smaller percentage of students failed in the photonics course in 2009 compared to 2008.

Student Evaluation Of The Course

Student evaluation of the course was carried out at end of the semester using an online survey delivered in the same manner as the online assessments. The survey consisted of 30 questions that evaluated the course, the teacher as well as the PBL practicals. Figure 6 lists the student responses for selected questions from the 2010 survey relating to the pre-reading, online assessments and increasing student engagement.

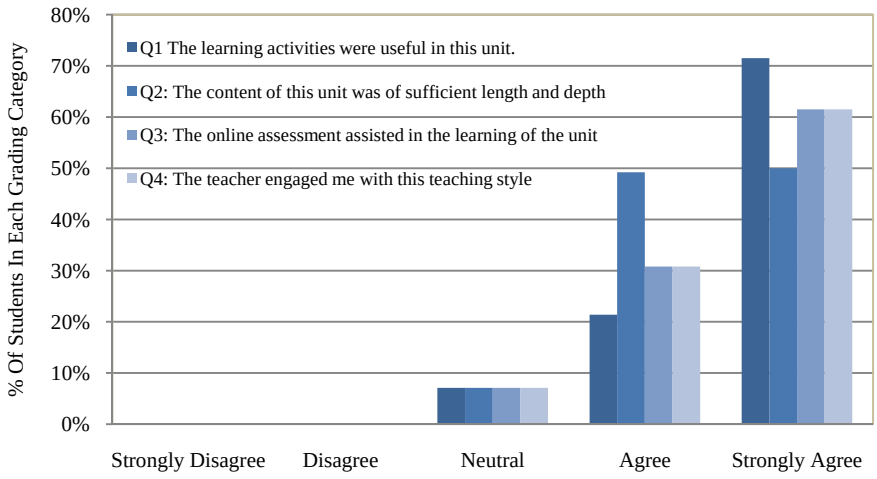

FIGURE 6

Percentage of student responses to survey for the questions (Q1): The learning activities were useful in this unit, (Q2): The content of this unit was of sufficient length and depth, (Q3): The online assessment assisted in the learning of the unit, (Q4): The teacher engaged me with this teaching style.

The survey showed that most students responded well towards this new mode of teaching. This is further evidenced in the open question in the survey that asked what the best aspects of the course were. The result is shown in figure 7 as a screen print of the survey results. The responses show an overwhelming support for doing the online assessments before class.

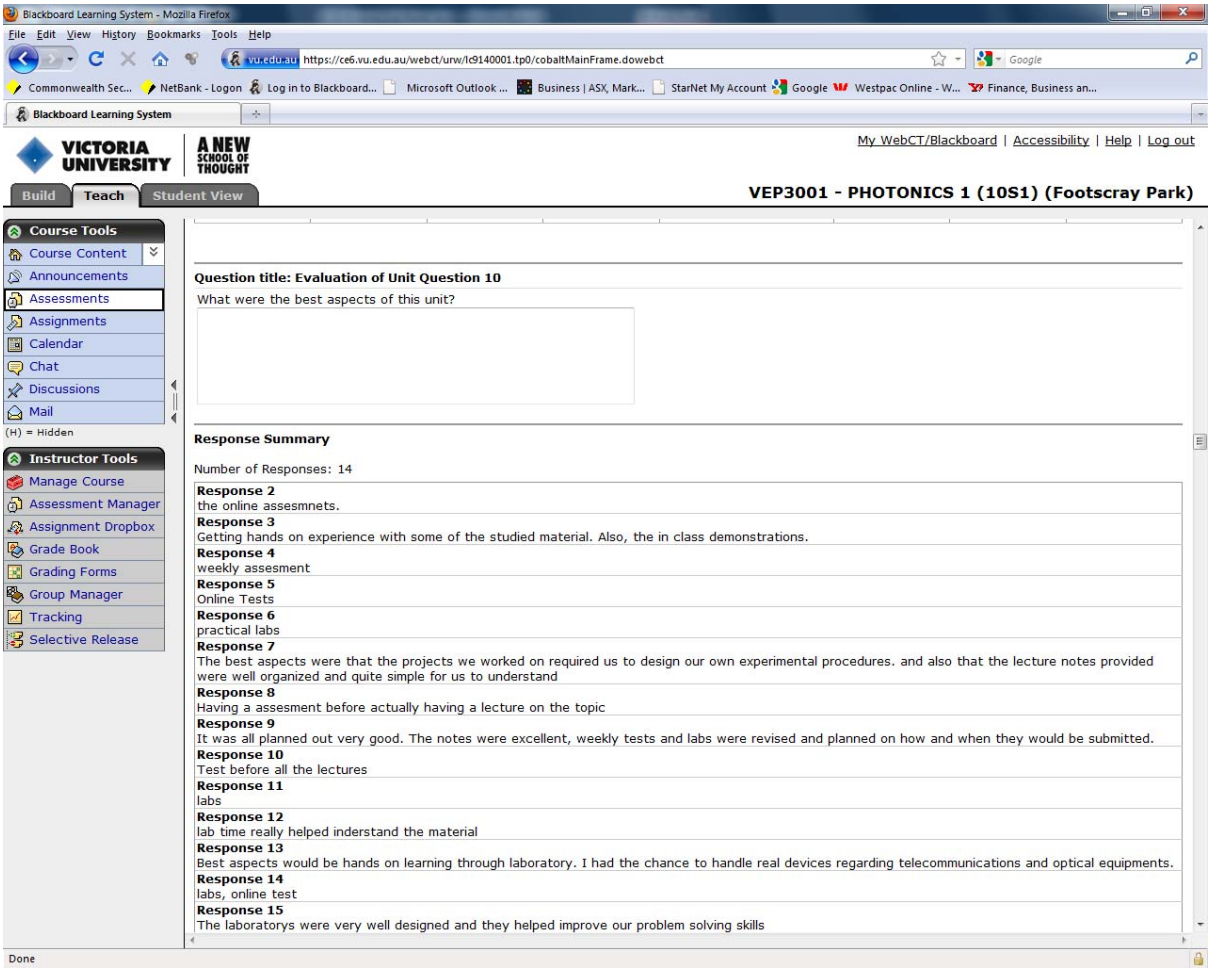

FIGURE 7

Student responses to what they thought were the best aspects of the course.

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CONCLUSION

This paper presented the experience of introducing pre-reading and assessment before each class in the photonics course. By making students learn the material before each class, students were better able to understand and assimilate the learning material being taught during lecture time. The online assessments that were required to be completed before each class allowed the teaching of that class to be customised according to the student's learning needs thereby making the learning more relevant, more effective and more engaging. Class learning was driven by the students. Student attendance throughout the teaching semester was consistently high indicating a high rate of engagement in, and enjoyment of, the course. This mode of teaching resulted in an overall improvement in student grades and student performance compared to other courses which the students concurrently take.

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